WHAT IS CLAIMED IS:

A system for enhancing intelligibility of a voice signal that is degraded by factors that reduce intelligibility of the voice signal, said system comprising:

an input configured to receive a voice signal that includes spoken words;

an aural filter operatively coupled to said input, said aural filter configured to filter said voice signal to produce a filter output signal wherein low frequencies below speech frequencies and high frequencies above speech frequencies are attenuated with respect to speech frequencies;

a speech explander operatively coupled to said aural filter to produce an expanded signal, said speech expander configured to amplify said filter output signal according to an amplifier gain, wherein said amplifier gain is a function of an envelope amplitude of said filter output signal; and

a combiner configured to combine at least a portion of said expanded signal and at least a portion of said voice signal to produce an enhanced signal representing said spoken words.

- 2. The system of Claim 1, wherein said system is configured to provide a transfer function that approximates an inverse of loudness contours for human hearing of tones in a sound field.
- 3. The system of Claim 1, wherein said speech expander comprises an envelope detector and a gain controlled amplifier, wherein at least a portion of said filter output signal is provided to an input of said envelope detector configured to detect an envelope amplitude of said at least a portion of said filter output signal.
- 4. The system of Claim 1, wherein said amplifier gain increases according to an attack time constant and said amplifier gain decreases according to a decay time constant.

A communication device for sending voice information communication receiver, where the voice information may become contaminated by noise that reduces the intelligibility of the voice information, said communication device comprising:



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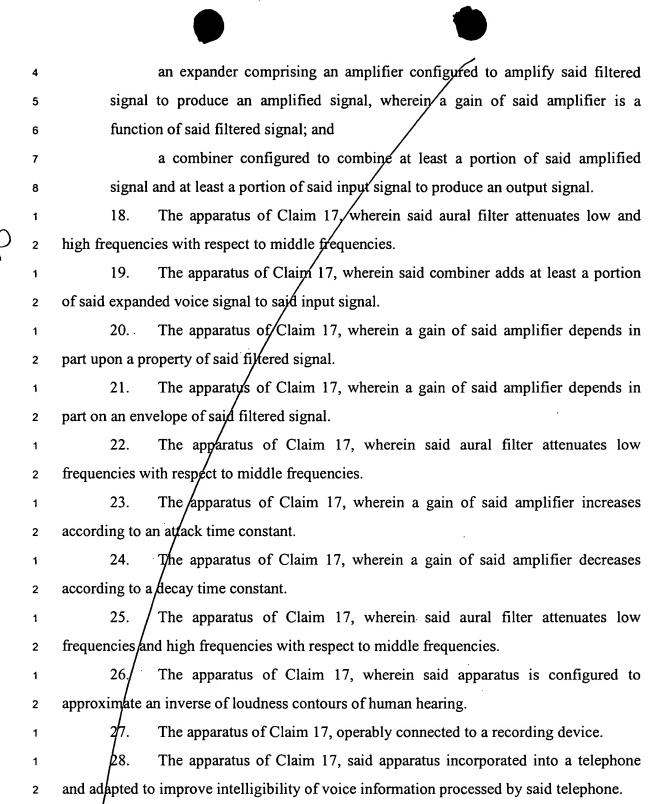
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5		a sender configured to send/a voice signal over a communication channel
6	and	
7		a voice enhancer operably connected to said sender, said voice enhancer
8	compr	ising:
9		an aural filter operatively coupled to a voice signal in said sender
10		said aural filter configured to filter said voice signal to produce a filter
11		output signal where n low frequencies below speech frequencies and high
12)	frequencies above speech frequencies are attenuated with respect to speech
13/	,	frequencies;
14		a speech expander operatively coupled to said aural filter to
15		produce an expanded voice signal, said speech expander configured to
16		amplify said filter output signal according to an amplifier gain, wherein
17		said amplifier gain is a function of an envelope amplitude of said filter
18		output signal; and
19		a dombiner configured to combine at least a portion of said
20		expanded voice signal and at least a portion of said voice signal to produce
21		an enhanced voice signal.
1	6.	The communication device of Claim 5, wherein said voice enhancer is
2	configured to	provide a transfer function that approximates an inverse of loudness
3	contours for h	uman hearing.
1	7.	The communication device of Claim 5, wherein said speech expander
2	comprises an	envelope detector and a gain controlled amplifier, wherein at least a portion
3	of said filter of	output signal is provided to an input of said envelope detector configured to
4	detect an enve	elope amplitude of said at least a portion of said filter output signal.
1	8.	The communication device of Claim 5, wherein said amplifier gain
2	increases acco	ording to an attack time constant and said amplifier gain decreases according
3	to a decay tim	ne constant.
1	9.	A communication device configured to receive voice information from a
2	communication	on sender, comprising:

3	а	communication receiver configured to receive voice information from a
4	commun	nication channel; and
5	а	voice enhancer operably connected to said communication receiver, said
6	voice en	hancer comprising:
7		an aural filter configured to filter an input signal to produce a
8	f	iltered signal;
9	%	an expander comprising an amplifier configured to amplify said
10	$\sqrt{2}$ f	iltered signal to produce an amplified signal, wherein a gain of said
11	\ a	implifier is a function of said filtered signal; and
12		a combiner configured to combine at least a portion of said
13	а	implified signal and at least a portion of said input signal to produce an
14	C	output signal.
1	10.	The communication device of Claim 9, wherein said communication
2	device is a cord	less telephone comprising a handset and a base unit.
1	11.	The communication device of Claim 9, wherein said communication
2	device is a cellu	lar telephone.
1	12. T	The communication device of Claim 9, wherein said aural filter attenuates
2	low and high fre	equencies with respect to middle frequencies.
1	13.	The communication device of Claim 9, wherein said combiner adds at least
2	a portion of said	expanded voice signal to said input signal.
1	14. 7	The communication device of Claim 9, further comprising a user control,
2	said user contro	configured to enable and disable said voice enhancer.
1	15.	he communication device of Claim 9, further comprising a user control,
2	said user contro	configured to vary an amount of enhancement produced by said voice
3	enhancer.	
1	16.	the communication device telephone of Claim 9, wherein said voice
2	enhancer is con	figured to approximate an inverse of loudness contours of human hearing.
1	/	n apparatus, comprising:
2	/ a	aural filter configured to filter an input signal to produce a filtered
3	signal;	·

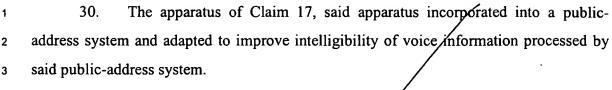




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and adapted to improve intelligibility of voice information processed by said hearing aid.

The apparatus of Claim 17, said apparatus incorporated into a hearing aid



- 31. The apparatus of Claim 17, said apparatus incorporated into a communication system and adapted to improve intelligibility of voice information processed by said communication system.
 - 32. The apparatus of Claim 17, wherein said aural filter is an analog filter.
 - The apparatus of Claim 17, wherein said aural filter is a digital filter. 33.
- A method for enhancing/intelligibility of voice information, comprising the steps of:

filtering at least a portion of a first signal that includes voice sounds to produce a filtered signal; and

expanding at least a portion of said filtered signal to produce an enhanced signal having voice sounds modified by an amount that approximates an inverse of loudness contours.

- 35. The method of Claim 34, further comprising the step of combining at least a portion of said first signal with said enhanced signal.
- 36. The method of Claim 35, wherein said step of combining comprises adding at least a portion of said first signal to said enhanced signal.
- The method of Claim 34, wherein said step of expanding comprises 37. amplifying said filtered signal using an amplifier having a variable gain.
- The method of Claim 37, wherein said variable gain is a function of at 38. least a portion of said filtered signal.
- The method of Claim 37, wherein said variable gain is a function of at least a portion of an envelope of said filtered signal.
 - 40. The method of Claim 37, wherein said variable gain is a function of at least a portion of an average power of said filtered signal.
 - 41. The method of Claim 37, wherein said variable gain is a function of at least a portion of said a square-root of the mean of the squares average of said filtered ₿ignal.



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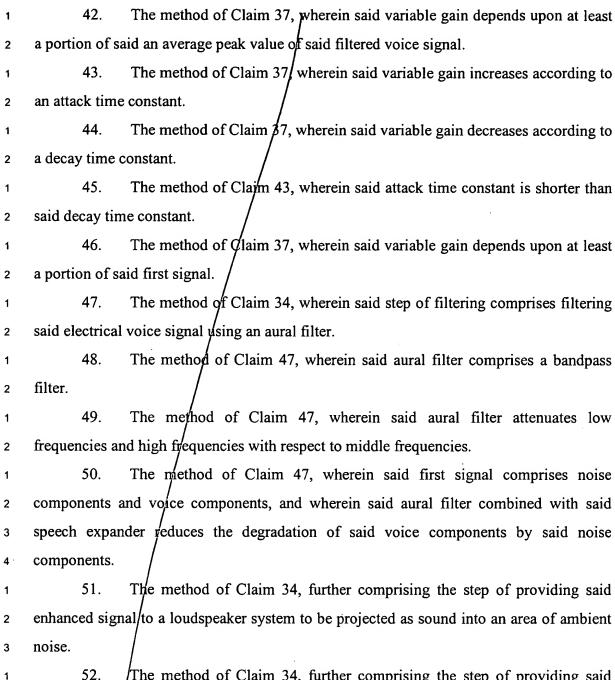
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52. The method of Claim 34, further comprising the step of providing said enhanced signal to a recording device. 2

A method for enhancing intelligibility of voice information, comprising the step of providing a signal including voice information to a signal processor having a transfer function, wherein said transfer function approximates an inverse of loudness contours for human hearing.



voice signal.

1	54. An apparatus for enhancing intelligibility of voice information, said
2	apparatus comprising: a signal processor configured to approximate an inverse of
3	loudness contours for human hearing.
1	An apparatus for enhancing intelligibility of voice information, said
2	apparatus comprising:
3	aural filter means for filtering an input signal to produce a filtered signal,
4	said input signal containing voice information; and
5	expander means for expanding said filtered signal to produce an expanded
6	signal.
1	56. The apparatus of Claim 55, further comprising combiner means for
2	combining at least a portion of said expanded signal with at least a portion of said input
3	signal.
1	57. An apparatus, comprising:
2	an input configured to receive an input signal; and
3	a dynamic filter configured to filter said input signal to produce an
4	enhanced signal with modified voice components, said dynamic filter configured
5	to provide a transfer function that approximates an inverse of loudness contours
6	for humans of a selected hearing acuity.
1	58. The apparatus of Claim 57, wherein said dynamic filter comprises a
2	bandpass filter and an expander.
1	59. The apparatus of Claim 57, wherein said dynamic filter comprises an aural
2	filter.
1	60. The apparatus of Claim 57, wherein said dynamic filter comprises a filter
2	that attenuates low and high frequencies relative to middle frequencies.
1	61. The apparatus of Claim 57, wherein said dynamic filter comprises an
2 .	expander.
1	62. The apparatus of Claim 57, further comprising a combiner configured to
2	combine at least a portion of said input signal with at least a portion of said enhanced

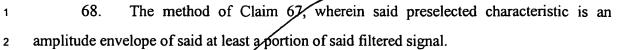


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	63. The apparatus of Claim 57, further comprising a user control, said control					
configured to allow a user to adjust a transfer function of said dynamic filter.						
	64. A method of improving the intelligibility of voice sounds contained within a					
	signal source when the signal source is reproduced through a loudspeaker, said method					
	comprising the following steps:					
	sensing an amplitude level of a signal source to produce a control signal;					
	filtering the signal source according to a frequency response related to					
	human hearing characteristics to produce a filtered signal;					
	modifying the frequency response used to filter said signal source wherein					
	the amount of modification is a function of the control signal; and					
	combining the signal source with the filtered signal to produce an output					
	signal having enhanced voice sounds.					
	65. The method of Claim 64, wherein said step of modifying the frequency					
	response comprises the step of increasing the gain of said frequency response in response to					
	an increase in the amplitude level of voice sounds within said signal source.					
	66. The method of Claim 64, wherein said signal source is part of a composite					
	multi-channel audio signal and said signal source contains voice sounds mixed with noise.					
	67. A method of emphasizing speech sounds contained within a signal source					
	to produce an output signal comprises the following steps:					
	filtering said signal source to produce a filtered signal wherein said filtered					
	signal includes a frequency range of said signal source containing at least some of said					
	speech sounds;					
	analyzing at least a portion of said filtered signal to produce a					
	control signal wherein said control signal represents a preselected characteristic of					
	said at least a portion of said filtered signal;					
	amplifying said filtered signal during an amplification period to					
	provide an enhancement signal wherein the level of amplification of said filtered					
	signal is a function of the control signal; and					
	combining said enhancement signal with said signal source to					
	produce an output signal.					

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- 69. The method of Claim 67, wherein said frequency range corresponds to a frequency range containing typical human speech.
- 70. The method of Claim 67, wherein said amplification period is a function of a predetermined decay time constant.
- 71. The method of Claim 67, wherein said signal source is part of a composite signal representing voice and ambient information for presentation to a listener.

